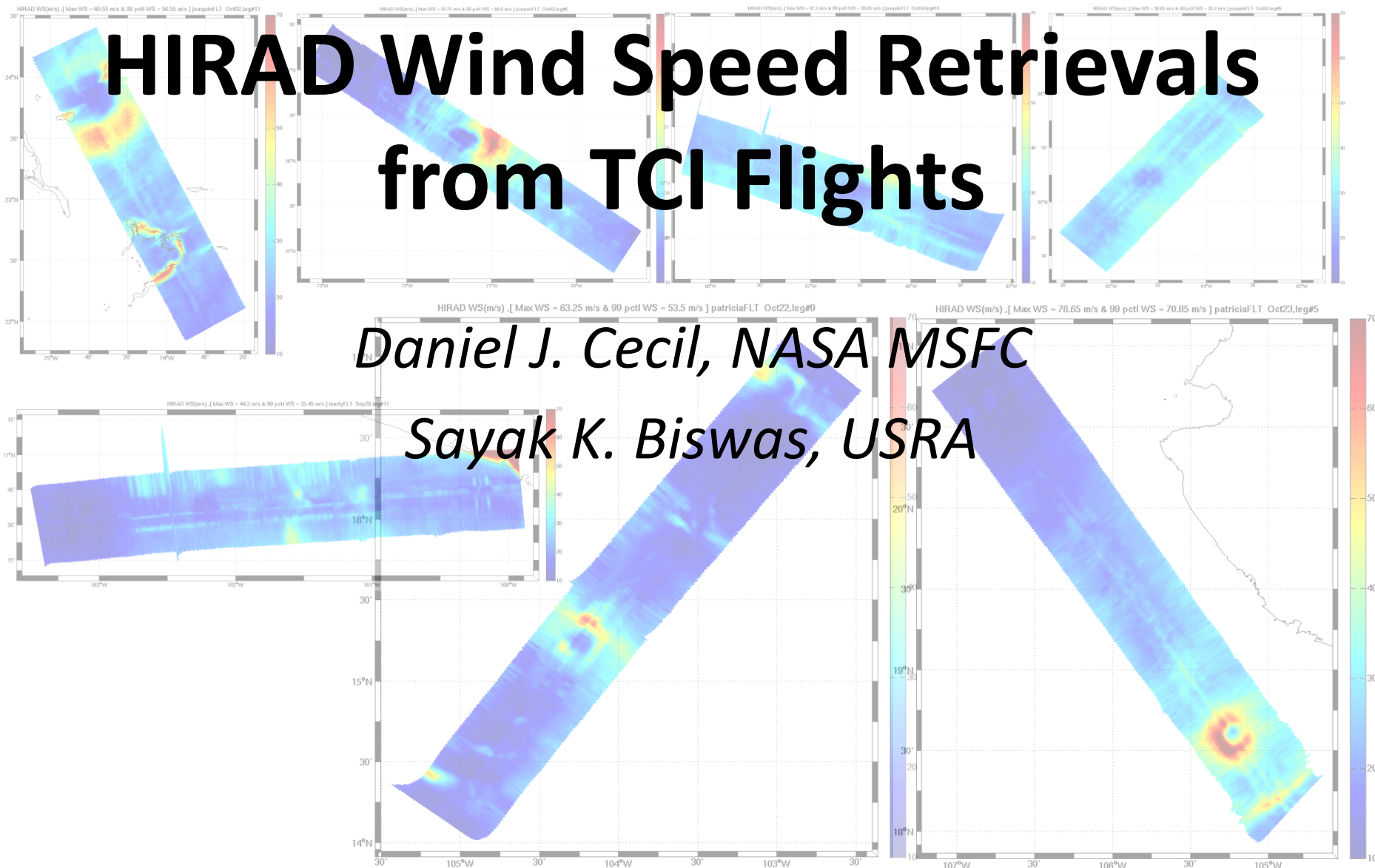


# HIRAD Wind Speed Retrievals from TCI Flights

*Daniel J. Cecil, NASA MSFC*

*Sayak K. Biswas, USRA*



## Hopefully data has been delivered to NCAR this week

- QC'd brightness temperature at 4.0, 5.0, 6.0, 6.6 GHz
- Retrieved Wind Speed and Rain Rate
- Geolocation
- 321 pixels per scan, but ~50 pixels at each edge of scan (> ~50° incidence angle) are especially questionable
- Retrievals are valid for winds ~15 m s<sup>-1</sup> and up
- Data is heavily oversampled
- Measurement footprint size ~1 km<sup>2</sup>

*This presentation has retrievals for one leg per flight; others being processed.*

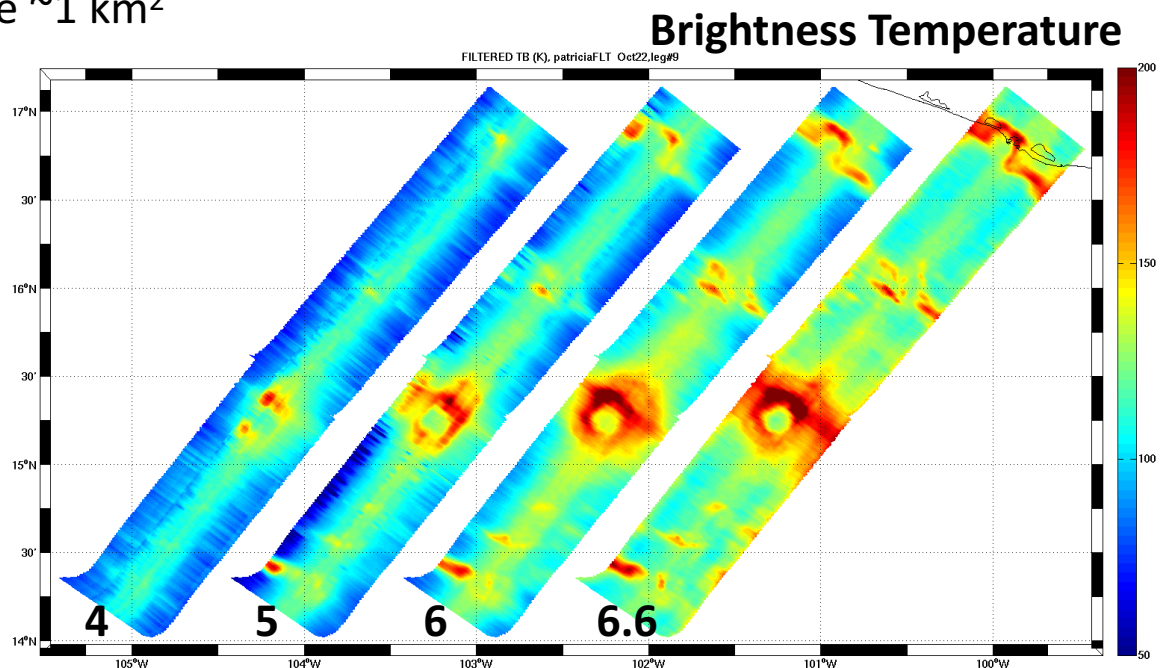
Marty 27-28 September 2015

Joaquin 02-05 October 2015

Patricia 21-23 October 2015

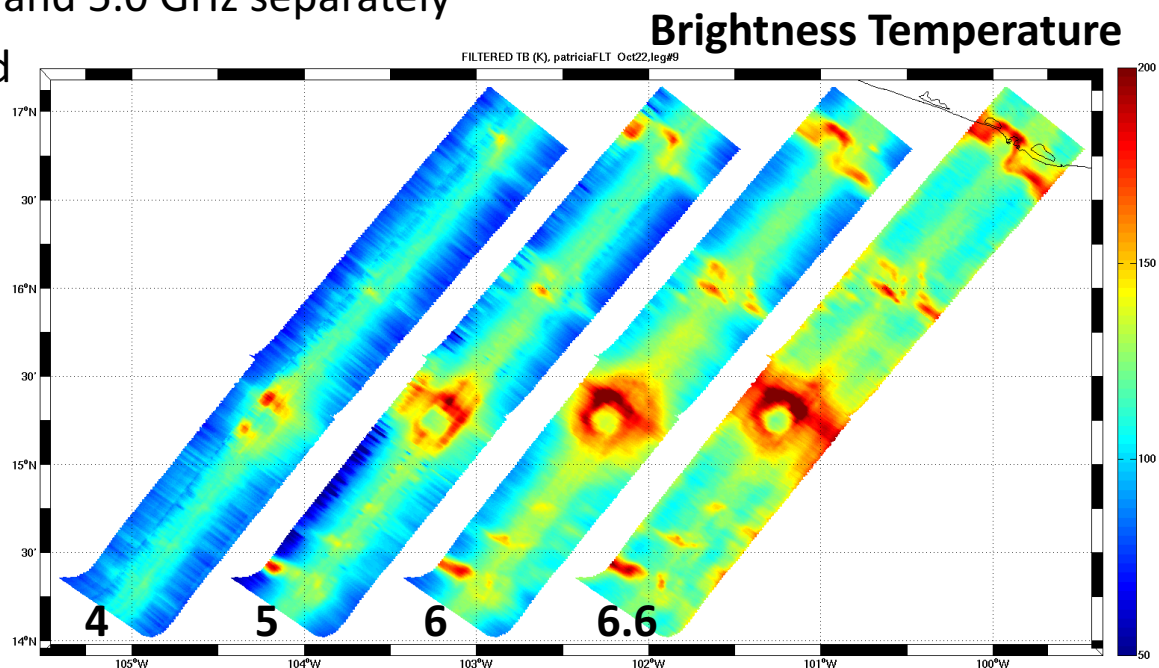
*Right:*

*Hurricane Patricia 22 October  
Brightness Temperatures at  
4.0, 5.0, 6.0, 6.6 GHz*



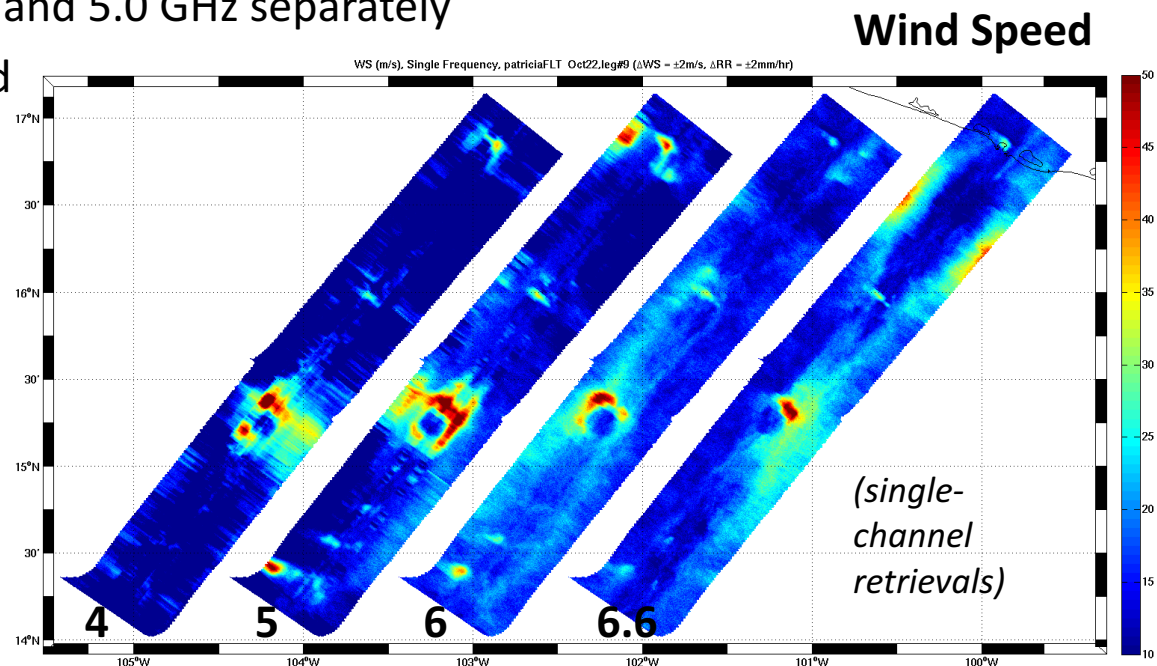
## Not necessarily the final version

- Lots of retrieval approaches available
- Chose approaches suitable for HIRAD's data characteristics
- All 4 channels are sensitive to wind and rain, but higher frequencies are much more sensitive to rain
- Lower frequencies depict wind more clearly (less rain contamination)
- Higher frequencies have better spatial resolution, less noise/smoothing
- Performed Single-channel retrievals (Constrained Maximum Likelihood Estimate – CMLE) from 4.0 and 5.0 GHz separately
- Used Wind Speed from 4.0 and 5.0 GHz retrievals to constrain possible MLE solutions from 6.0 and 6.6 GHz
- Relies on low frequencies for first-guess wind field, then allows high frequencies to account for rain and improve spatial structure



## Not necessarily the final version

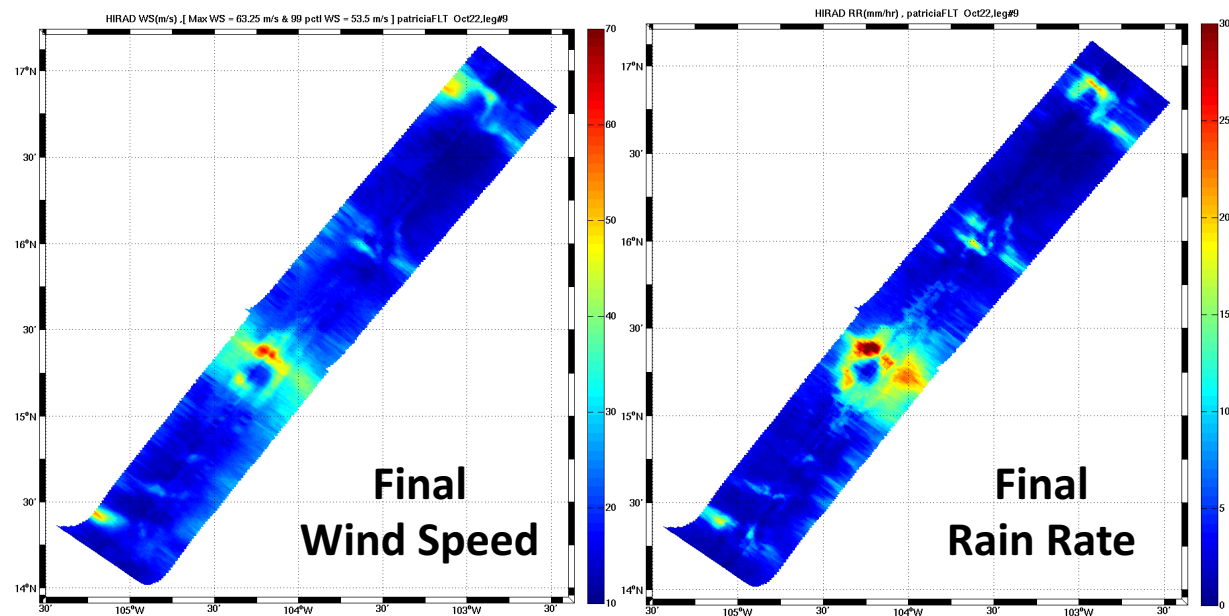
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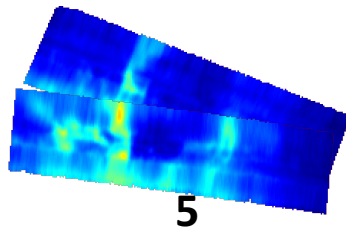
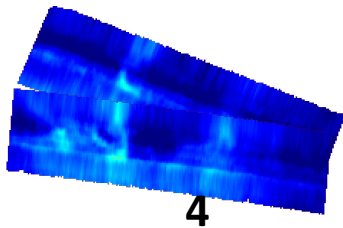




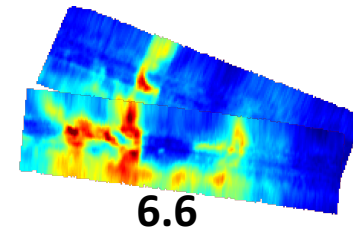
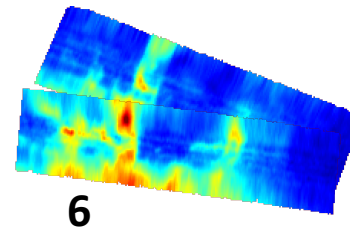
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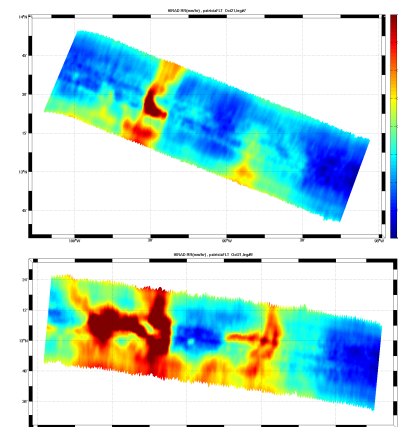
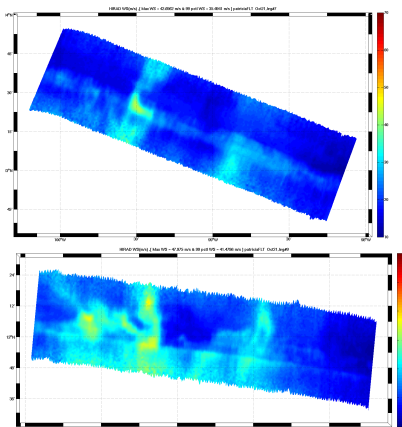


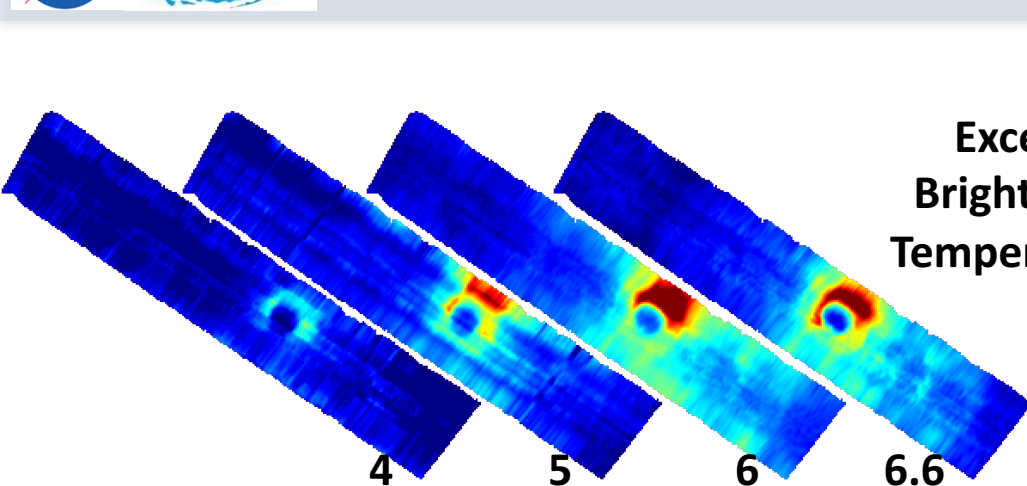
Excess  
Brightness  
Temperature



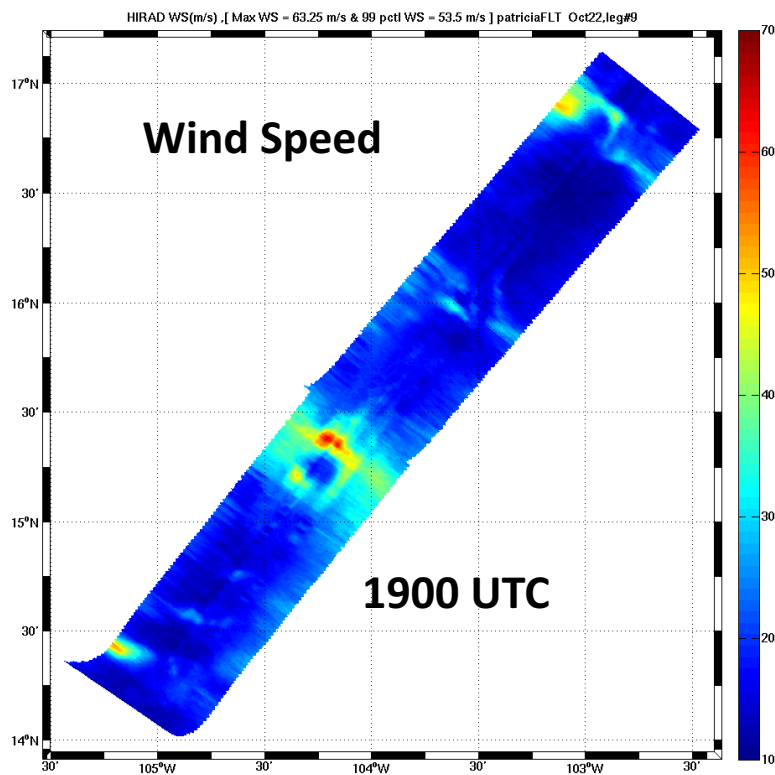
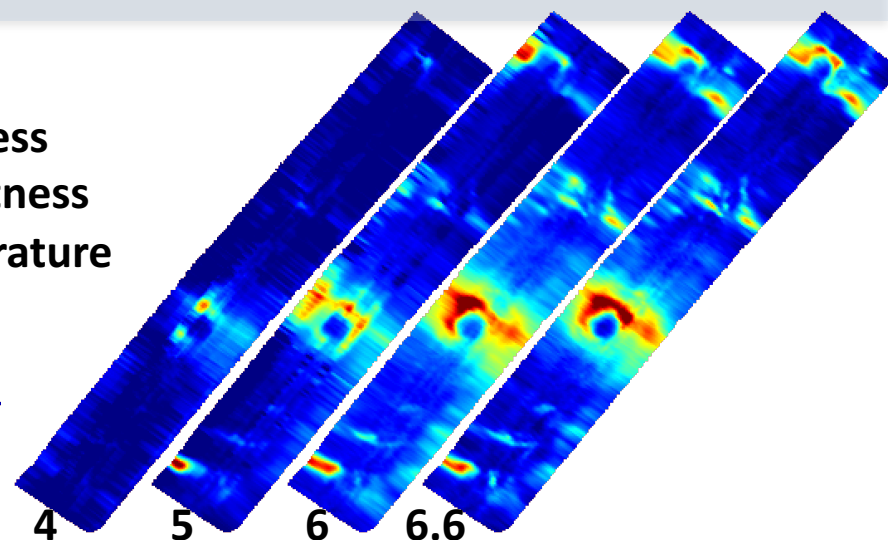
Wind Speed

Rain Rate

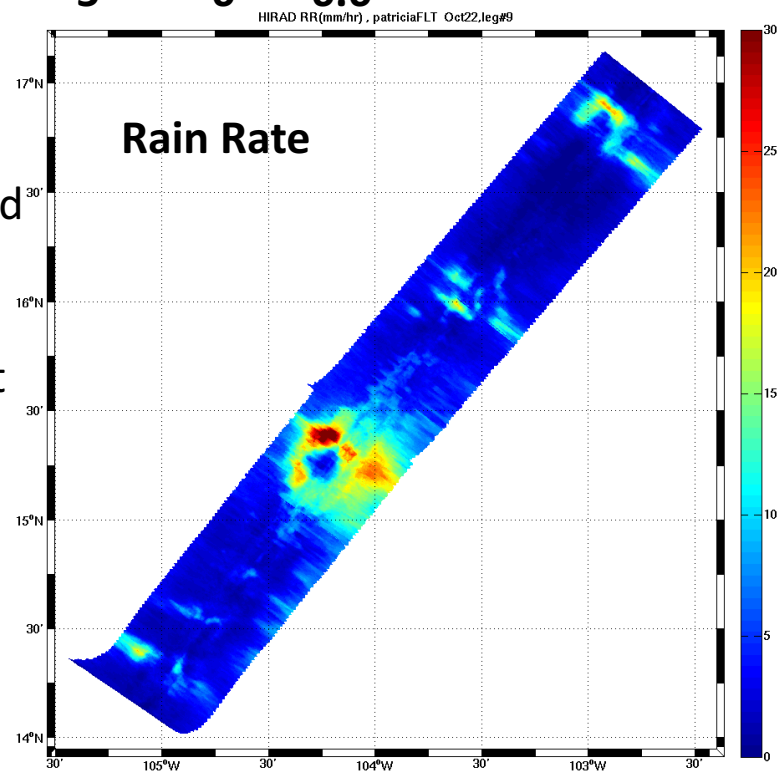


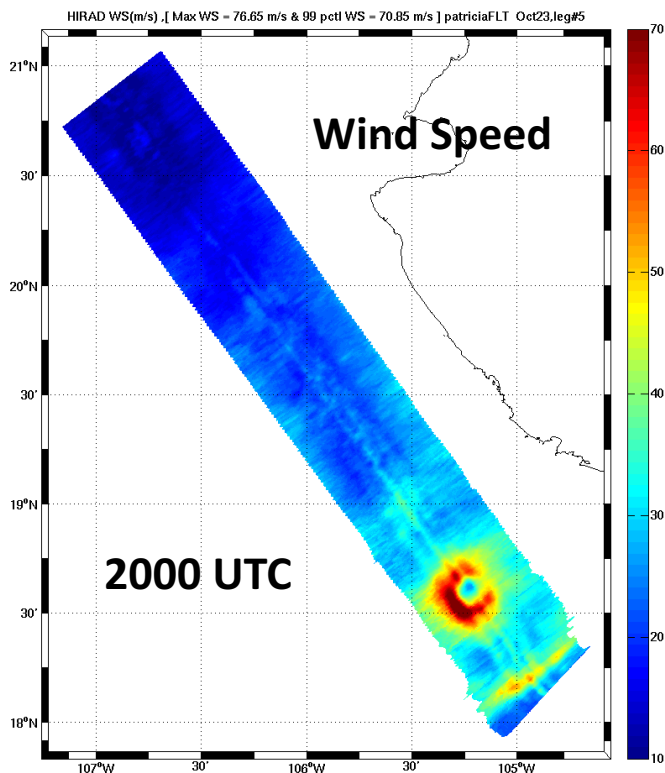
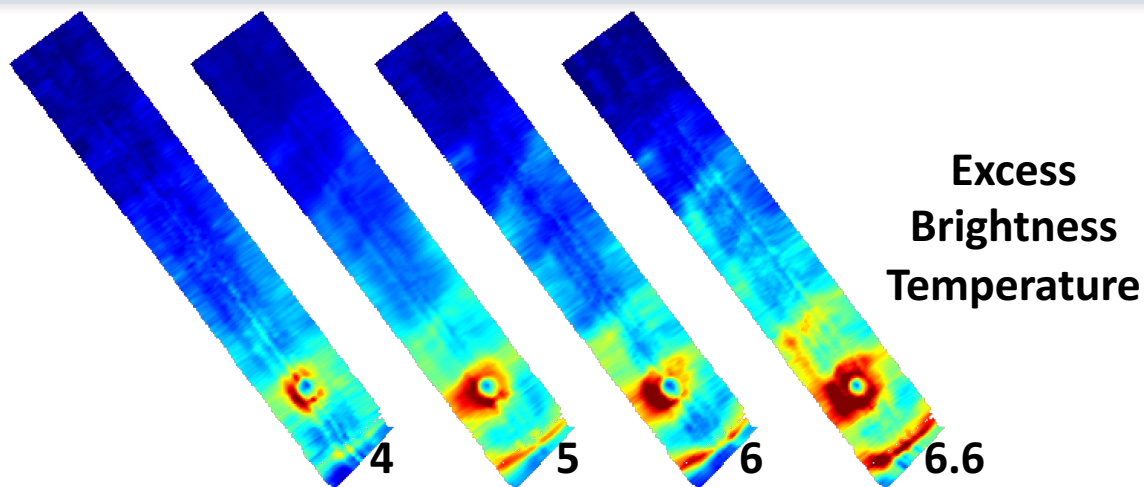


Excess  
Brightness  
Temperature

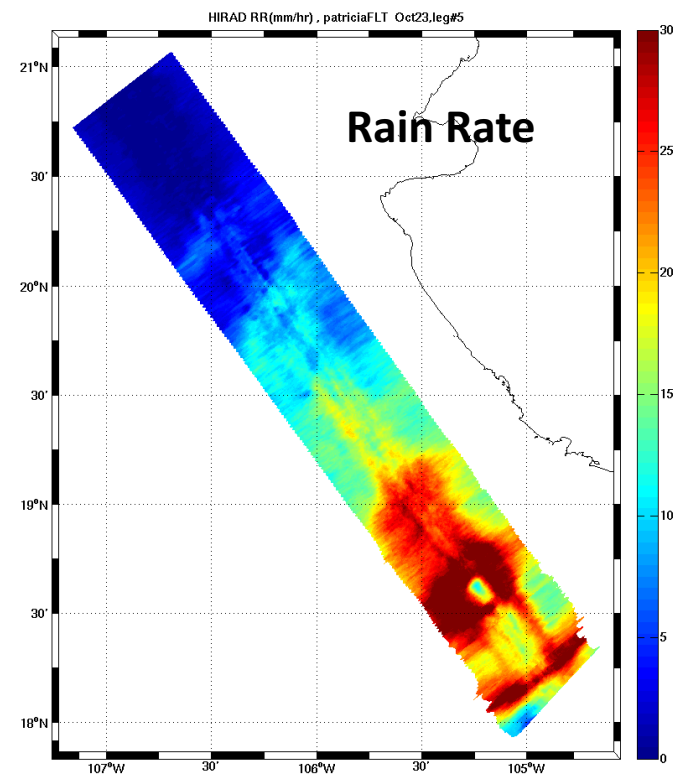


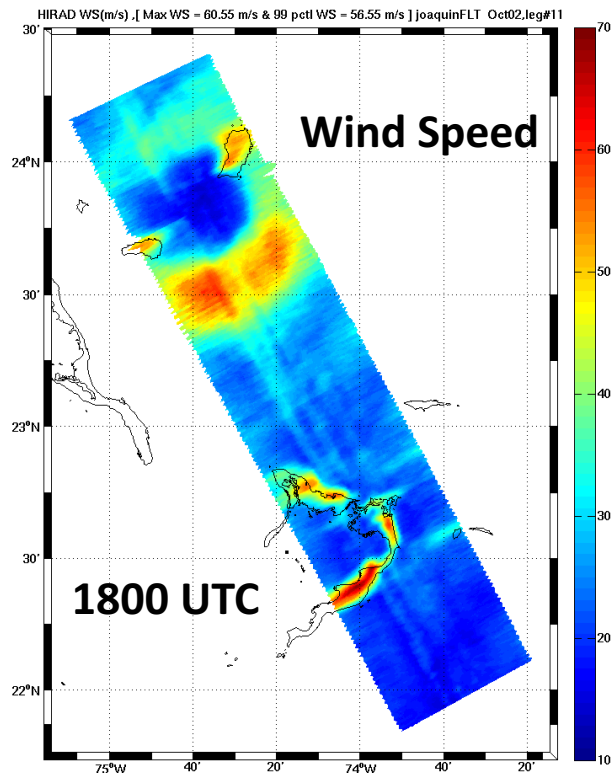
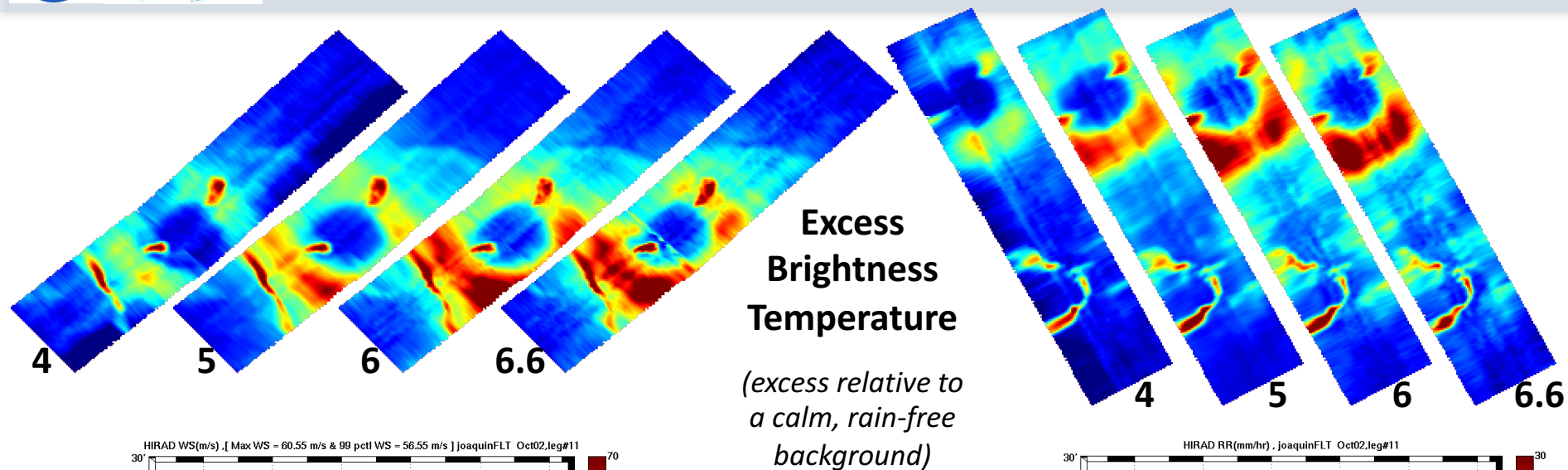
123 kt Max Wind  
104 kt 99<sup>th</sup> %ile  
within 200 km  
120 kt NHC Best  
Track





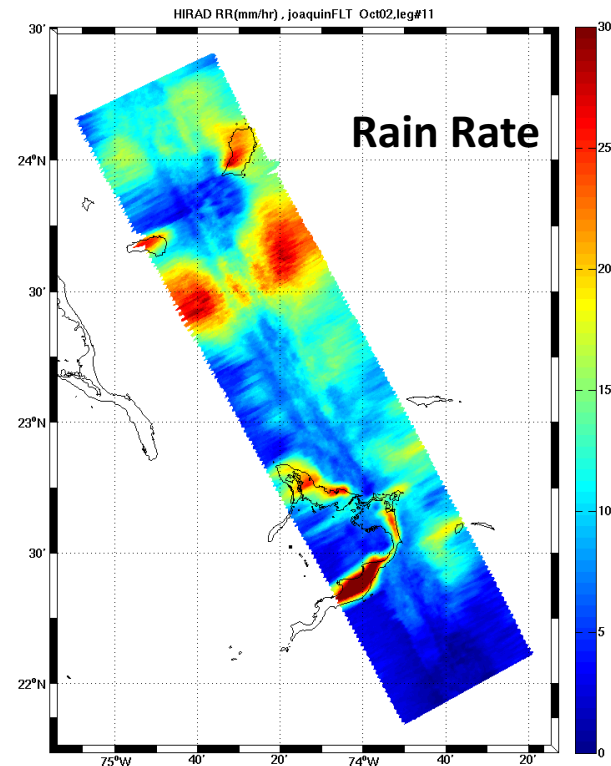
149 kt Max Wind  
138 kt 99<sup>th</sup> %ile within  
200 km  
160 kt NHC Best Track



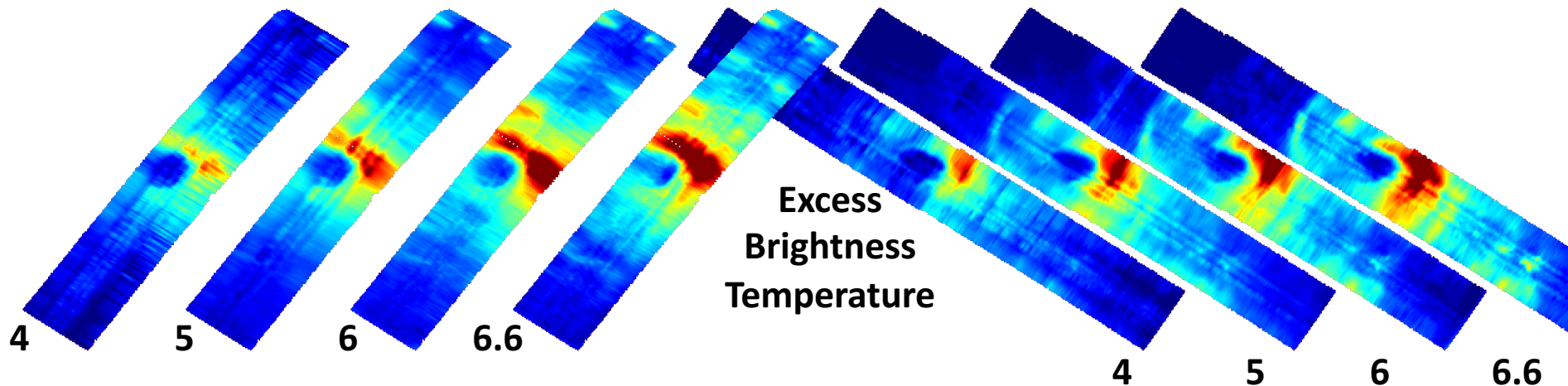


110 kt NHC Best Track

*(As seen in this example, islands were not screened out before running retrievals, but they should be disregarded)*







HIRAD WS(m/s) . [ Max WS = 76.75 m/s & 99 pctl WS = 60.6 m/s ] joaquinFLT Oct03,leg#6

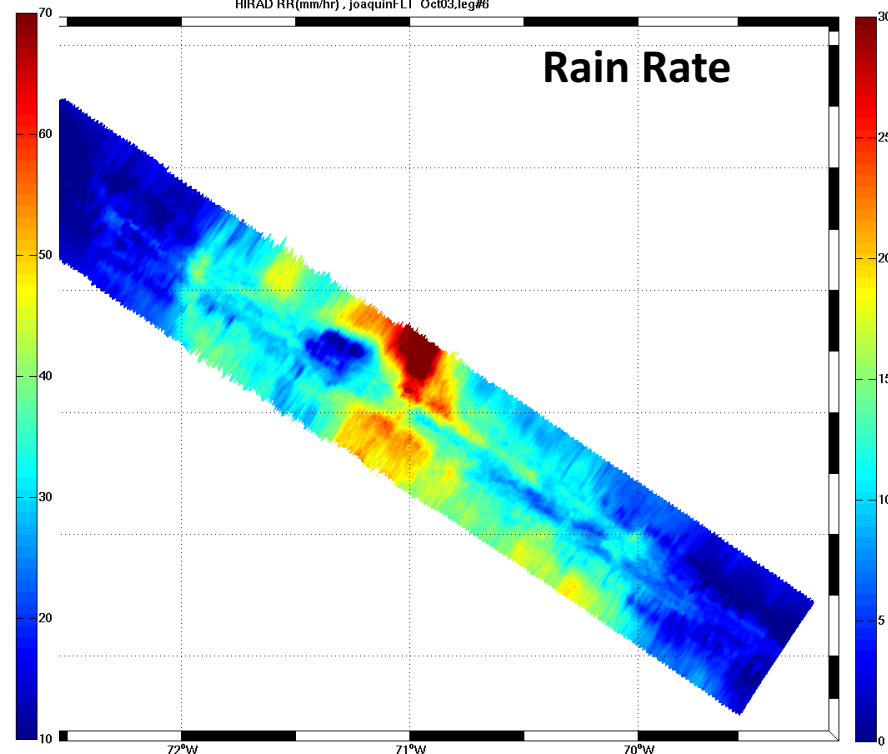
## Wind Speed

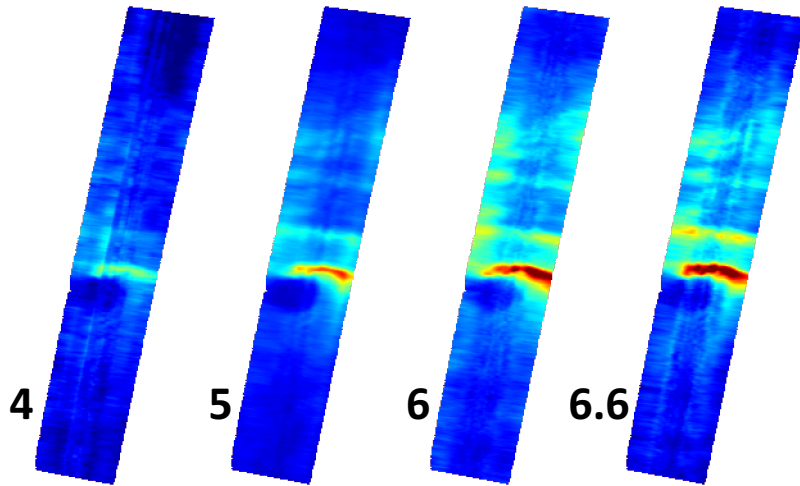
149 kt Max Wind  
118 kt 99<sup>th</sup> %ile within 200 km  
130 kt NHC Best Track

1700 UTC

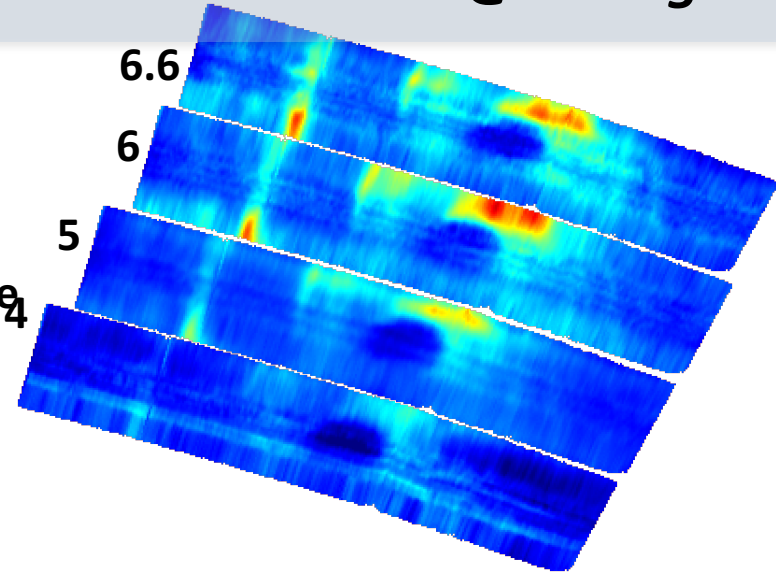
HIRAD RR(mm/hr) . joaquinFLT Oct03,leg#6

## Rain Rate





Excess  
Brightness  
Temperature

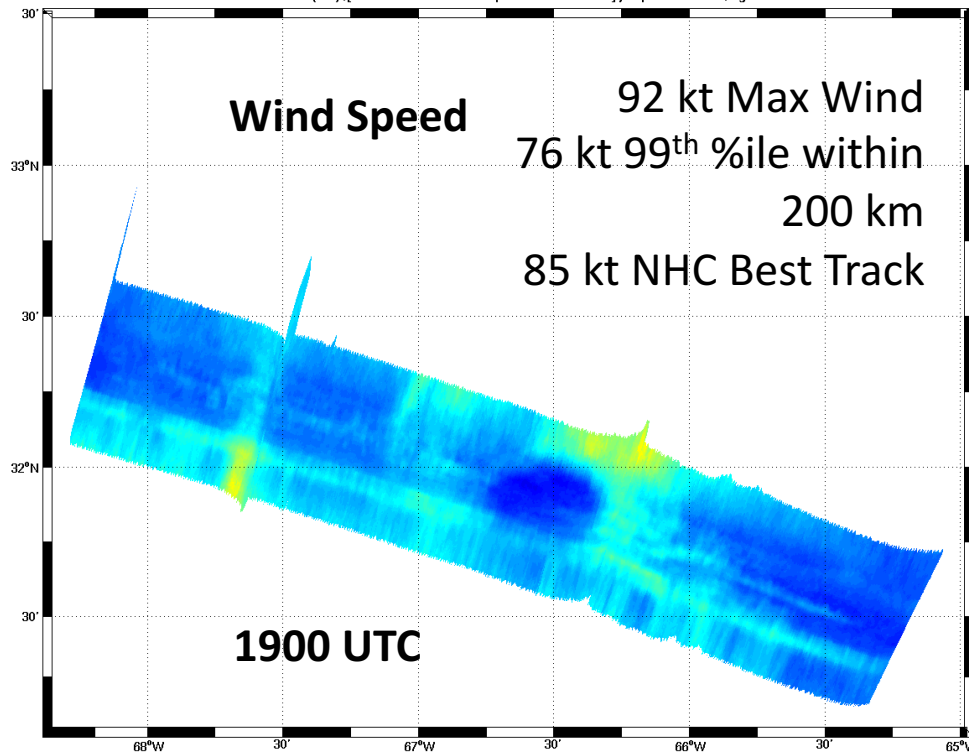


HIRAD WS(m/s) .[ Max WS = 47.3 m/s & 99 pctl WS = 38.85 m/s ] joaquinFLT Oct04,leg#10

**Wind Speed**

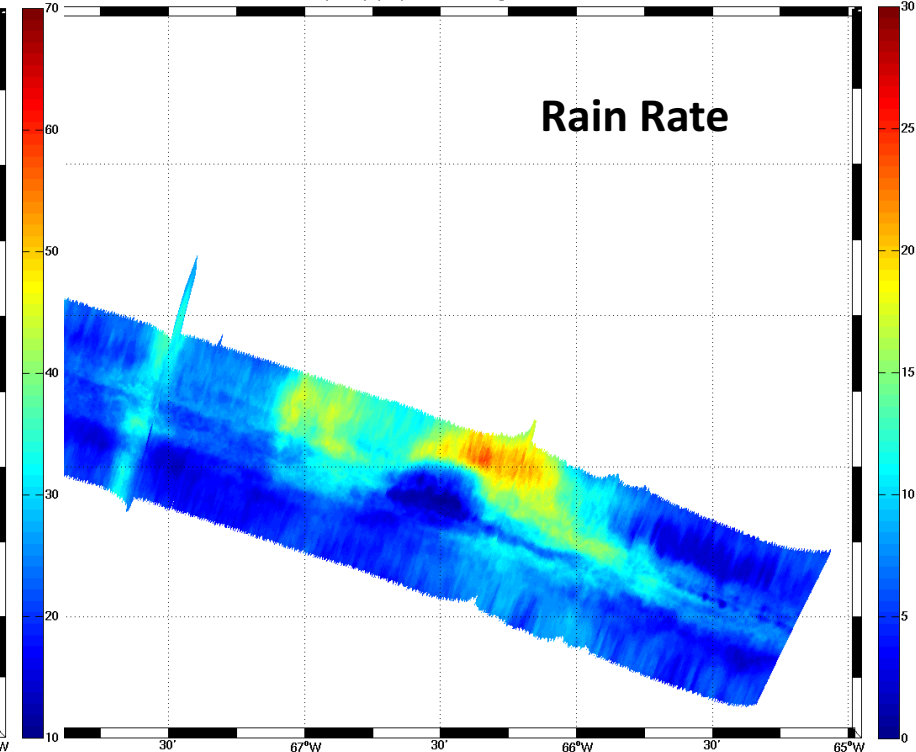
92 kt Max Wind  
76 kt 99<sup>th</sup> %ile within  
200 km  
85 kt NHC Best Track

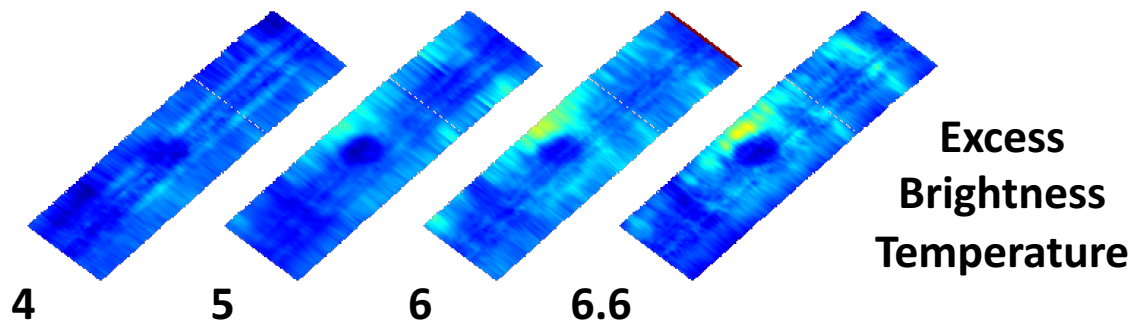
**1900 UTC**



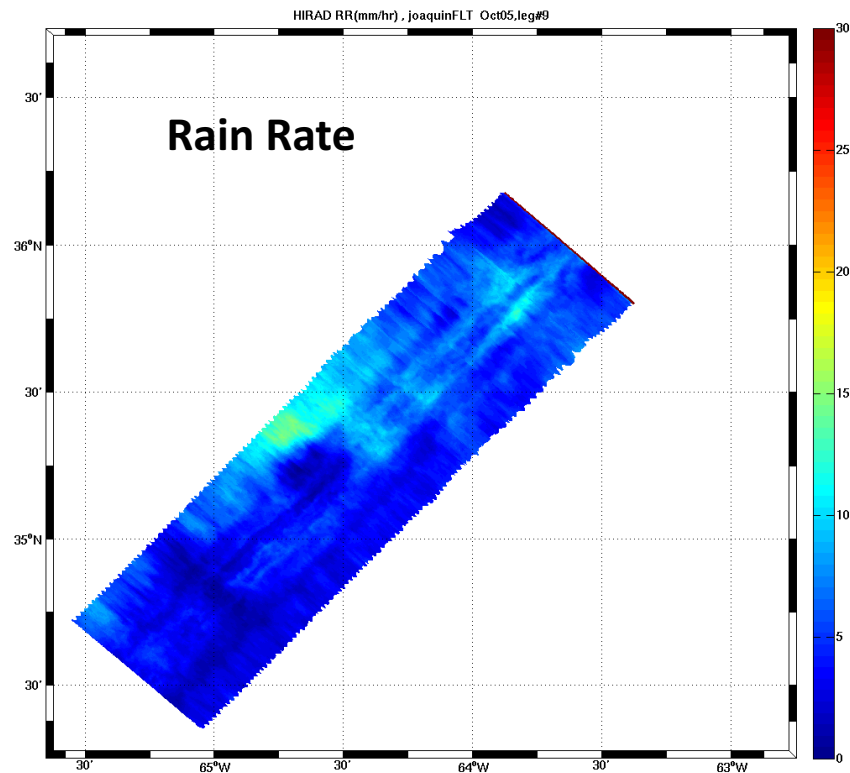
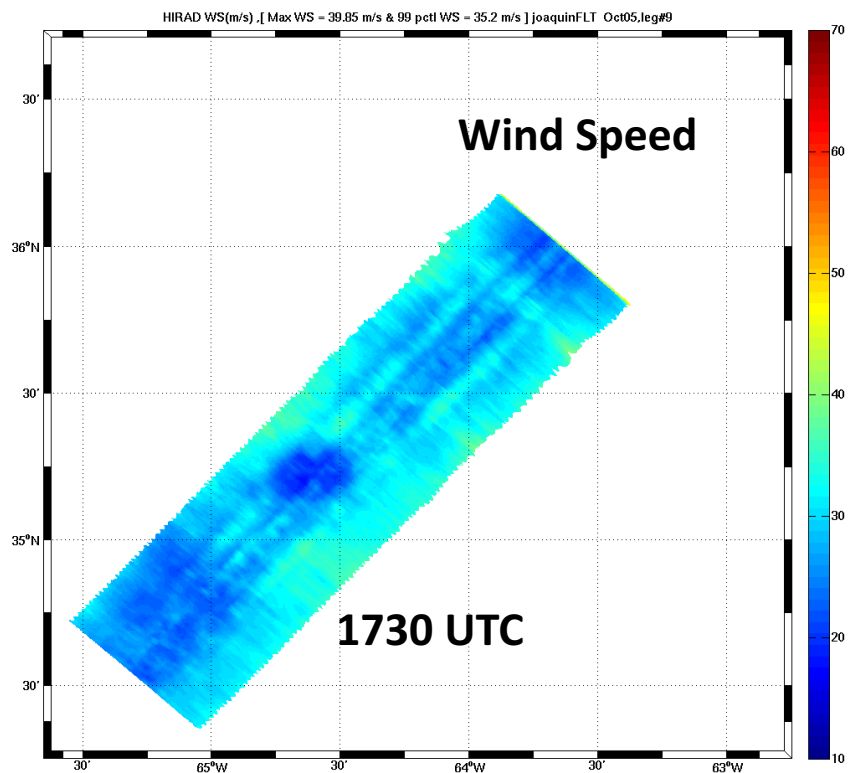
HIRAD RR(mm/hr) . joaquinFLT Oct04,leg#10

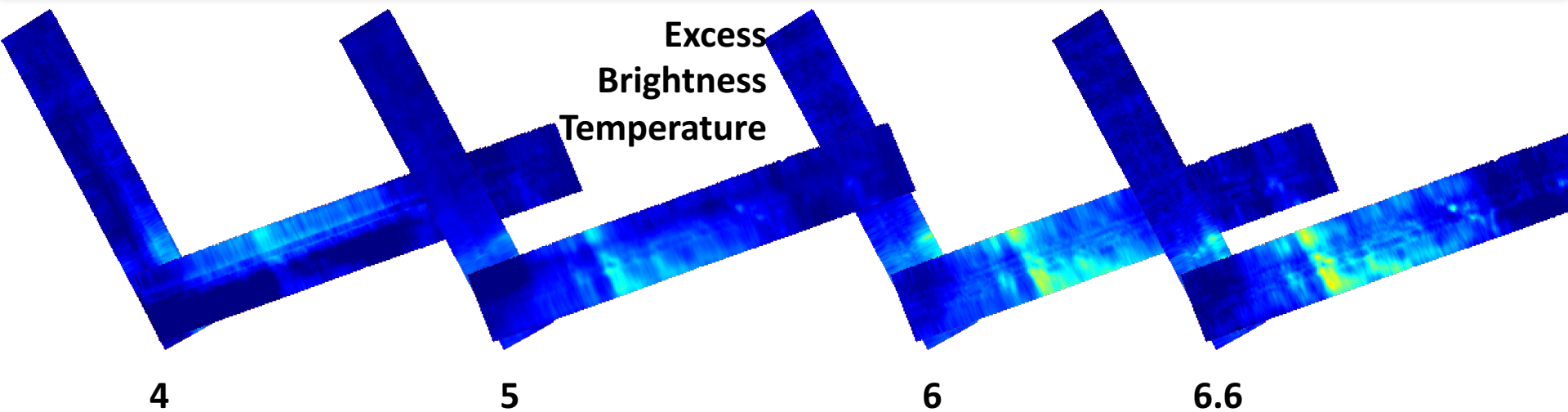
**Rain Rate**





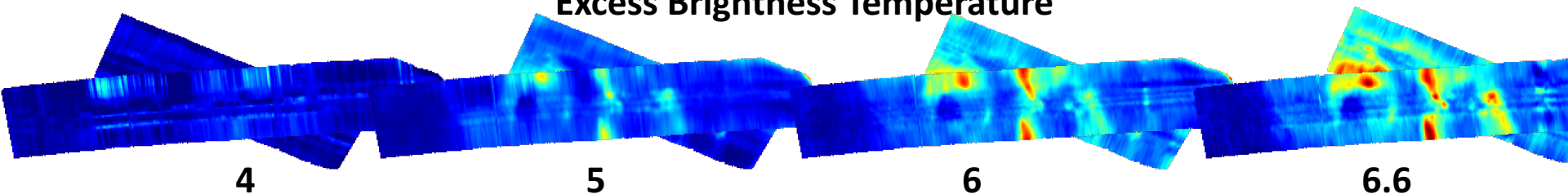
77 kt Max Wind  
68 kt 99<sup>th</sup> %ile within 200 km  
75 kt NHC Best Track



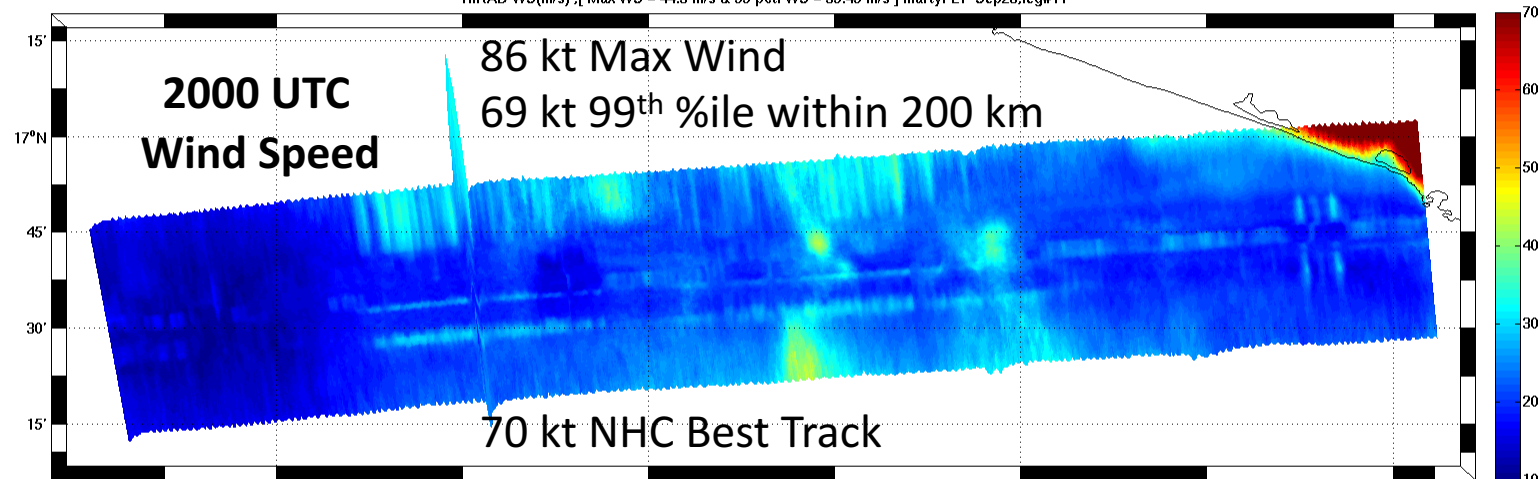


*retrieval images  
unavailable (still being  
processed while  
presentation prepared)*

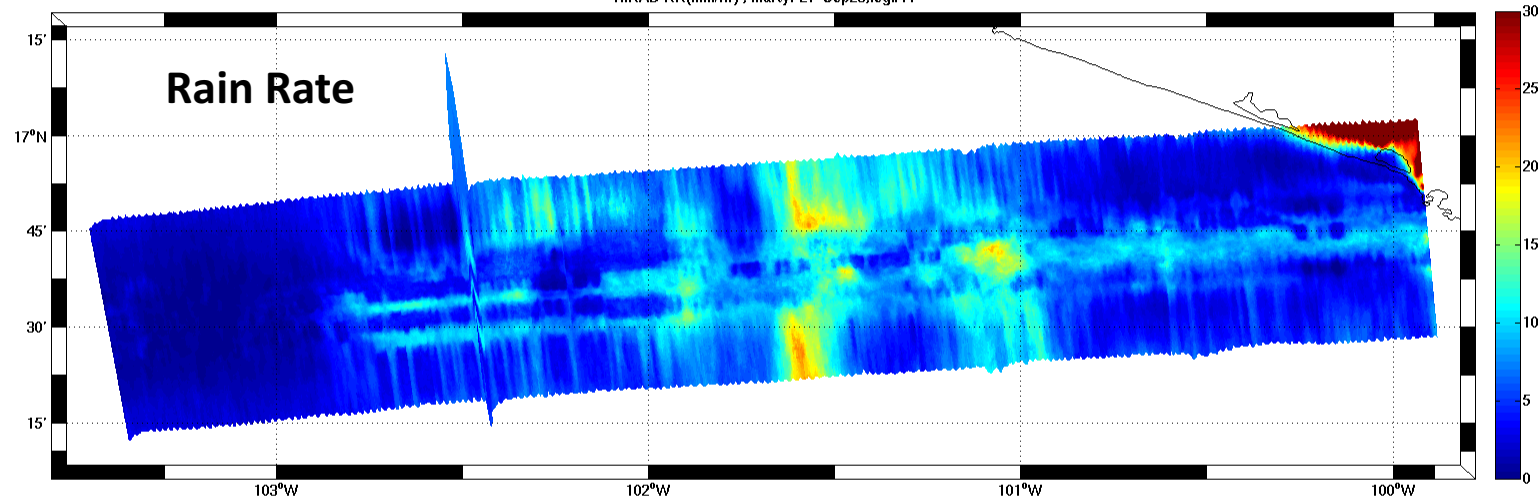
## Excess Brightness Temperature



HIRAD WS(m/s) , [ Max WS = 44.3 m/s & 99 pctl WS = 35.45 m/s ] martyFLT Sep28,leg#11



HIRAD RR(mm/hr) , martyFLT Sep28,leg#11





- HIRAD wind speed retrievals (and TB, rain rate) should be delivered to TCI data archive at NCAR this week
- Retrievals are valid for winds  $\sim 15 \text{ m s}^{-1}$  and up
- Retrievals may be improved in a subsequent release (we're working on it)
- Sometimes spatial patterns appear more coherent in excess brightness temperature imagery than in retrievals – *there may be ways to improve the spatial patterns of the retrievals based on this*
- Quantitative comparison with validation data remains to be done

